HIGH-PERFORMANCE MEMBRANE ELECTRODE UNIT AND THE USE THEREOF IN FUEL CELLS

Examiner: Adam Arciero S.N. 10/589,844 Art Unit 1727 February 10, 2012

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The claim rejections under 35 U.S.C. 103(a) as being unpatentable over Bjerrum et al. and Buchanan et al. on claims 1 and 3-24 and 28-34 are maintained. The rejection on claim 36 is withdrawn, in light of Applicant's amendment to the claim.

2. Claims 1 and 3-24 and 28-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bjerrum et al. (WO 01/18894 A2, found in IDS) in view of Buchanan et al. (US 5,759,944 A).

As to Claims 1 and 31, Bjerrum et al. discloses a membrane electrode assembly comprising an acid-doped solid electrolyte including at least one polymer with at least one nitrogen atom (polybenzimidazole) (pg. 9, line 15 to pg. 10, line 5) and at least one mineral acid (phosphoric acid) (pg. 13, lines 19-30). Bjerrum et al. discloses wherein at least one electrode comprises a catalyst comprising a composite of platinum with chromium, titanium or tungsten (pg. 16, lines 20-26). Bjerrum et al. does not specifically disclose wherein the catalyst comprises at least one precious metal of the platinum group, and/or at least one precious metal Au and/or Ag, as well as Ni.

However, Buchanan et al. teaches of a phosphoric acid fuel cell comprising a catalytically active layer comprising a catalyst composition consisting essentially of platinum

alloyed with Ni and Au (col. 1, line 54, to col. 2, line 8). Buchanan et al. is clearly teaching that Ni and Ti for use with platinum as a catalyst for a fuel cell electrode are considered functionally equivalent. Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to substitute the Pt/Au/Ni catalyst layer of Buchanan et al. for the Pt/Ti catalyst layer of Bjerrum et al., because Buchanan et al. teaches that they are recognized equivalents. Furthermore, it would have been obvious at the time of the invention to modify the catalyst of Bjerrum et al. with a Pt/Au/Ni catalyst, because Buchanan et al. teaches that the power density of the fuel cell stack can be increased while reducing the capital cost per unit of power, thereby providing a fuel cell with improved performance (col. 1, lines 10-37).

As to Claims 3-5, Bjerrum et al. discloses wherein the membrane comprises an alkaline polymer containing at least one aromatic ring with at least one nitrogen atom, such as polybenzimidazole (pg. 9, line 15 to pg. 10, line 5).

As to Claim 6, Bjerrum et al. discloses wherein the membrane comprises a polymer blend of more than one polymer (pg. 9, line 15 to pg. 10, line 13).

As to Claims 7 and 34, Bjerrum et al. discloses wherein the at least one mineral acid is phosphoric acid (pg. 13, lines 19-30).

As to Claim 8, Bjerrum et al. discloses wherein said membrane comprises para-polybenzimidazoles (pg. 9, lines 29-35).

As to Claims 9-22 and 32, it is noted that claims 9-22 and 32 are product-by-process claims. "Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the

same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). Since Bjerrum et al.'s membrane is the same to that of the Applicant's, Applicant's process is not given patentable weight in this claim.

As to Claim 23, Bjerrum et al. discloses wherein at least one electrode comprises a catalyst comprising platinum (pg. 16, lines 20-26).

As to Claim 24, Bjerrum et al. discloses wherein the catalyst is applied to the membrane (pg. 16, lines 20-22).

As to Claims 28 and 33, Bjerrum et al. discloses wherein the catalyst loading of the membrane electrode unit is 0.1 mg/cm^2 to 1.0 mg/cm^2 (pg. 17, lines 4-17).

As to Claim 29, Bjerrum et al. discloses wherein the catalyst particles include carbon as a support ((pg. 17, lines 4-17).

As to Claim 30, Bjerrum et al. discloses wherein the weight ratio of catalyst particles is in a range of 1:100 or 100:1 (pg. 16, lines 20-22).

As to Claims 35-36, Bjerrum et al. discloses wherein at least one electrode comprises a catalyst comprising a composite of platinum with chromium, titanium or tungsten (pg. 16, lines 20-26). Bjerrum et al. does not specifically disclose wherein the catalyst comprises at least one precious metal of the platinum group, and/or at least one precious metal Au and/or Ag, as well as Ni.

However, Buchanan et al. teaches of a phosphoric acid fuel cell comprising a catalytically active layer comprising a catalyst composition such as platinum alloyed with Ni and Au (col. 1, line 54, to col. 2, line 8). Buchanan et al. is clearly teaching that Ni and Ti for use

with platinum as a catalyst for a fuel cell electrode are considered functionally equivalent. Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to substitute the Pt/Au/Ni catalyst layer of Buchanan et al. for the Pt/Ti catalyst layer of Bjerrum et al., because Kiefer et al. teaches that they are recognized equivalents. Furthermore, it would have been obvious at the time of the invention to modify the catalyst of Bjerrum et al. with a Pt/Au/Ni catalyst, because Buchanan et al. teaches that the power density of the fuel cell stack can be increased while reducing the capital cost per unit of power, thereby providing a fuel cell with improved performance (col. 1, lines 10-37). The catalyst of Bjerrum et al. and Buchanan et al. consists of Pt/Au/Ni.

3. The claim rejections under 35 U.S.C. 103(a) as being unpatentable over Bjerrum et al., Buchanan et al. and Kiefer et al. on claims 2 and 25-27 are maintained.

4. Claims 2 and 25-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bjerrum et al. (WO 01/18894 A2, found in IDS) in view of Buchanan et al. (US 5,759,944 A), as applied to claims 1 and 3-24 and 28-34 above, and in further view of Kiefer et al. (US 2005/0084727 A1).

As to Claim 2, Bjerrum et al. and Buchanan et al. do not specifically disclose wherein a polyphosphazene is employed as the polymer with at least one nitrogen atom.

However, Kiefer et al. teaches of a PEM comprising a polymer with a nitrogen atom such as a polyphosphazene polymer or a polyazole (polybenzimidazole) (paragraph [0041]). Kiefer is identifying the two polymers as functional equivalents for use in membranes of fuel cells. The

courts have found that since both Bjerrum et al. and Kiefer et al. both teach a suitable polymer for a membrane in a fuel cell, it would have been *prima facie* obvious to substitute one material for the other. Express suggestion to substitute one equivalent for another need not be present to render such substitution obvious. See MPEP 2144, KSR.

As to Claim 25, Bjerrum et al. and Buchanan et al. do not specifically disclose wherein the catalyst layer has a thickness of 0.1 to 50 microns.

However, Kiefer et al. teaches of a catalyst layer with a preferable thickness in the range of 1 to 1,000 microns. This overlaps the claimed ranges. The courts have held that when "a prior art reference that discloses a range encompassing a somewhat narrower claimed range is sufficient to establish a *prima facie* case of obviousness." *In re Peterson*, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382-83 (Fed. Cir. 2003).

As to Claims 26-27, Bjerrum et al. and Buchanan et al. do not specifically disclose the particle sizes of the catalyst.

However, Kiefer et al. teaches of catalyst particles with a preferable size of 1 to 1,000 nm (paragraph [0166]). This overlaps the claimed ranges. The courts have held that when "a prior art reference that discloses a range encompassing a somewhat narrower claimed range is sufficient to establish a *prima facie* case of obviousness." *In re Peterson*, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382-83 (Fed. Cir. 2003).

5. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bjerrum et al. (WO 01/18894 A2, found in IDS) in view of Buchanan et al. (US 5,759,944 A) as applied to claims 1 and 3-24 and 28-34 above, and in further view of Itoh et al. (US 5,876,867).

As to Claim 36, the combination of Bjerrum et al. and Buchanan et al. does not specifically disclose wherein the catalyst consists of on precious metal of the platinum group and Ni or Au/Ni or Ag/Ni.

However, Itoh et al. teaches of a platinum alloy-supported catalyst consisting of platinum alloyed with another metal such as nickel (col. 3, lines 20-46). At the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the catalyst of Bjerrum et al. and Buchanan et al. with a platinum-nickel alloy, because Itoh et al. teaches that such a catalyst has a superior electrochemical oxygen reduction activity, superior long-term stability and the catalyst exhibits a higher out-put and a longer lifetime (col. 3, lines 1-5).

6. Claim 37 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bjerrum et al. (WO 01/18894 A2, found in IDS) in view of Itoh et al. (US 5,876,867).

As to Claim 37, Bjerrum et al. discloses a membrane electrode assembly comprising an acid-doped solid electrolyte including at least one polymer with at least one nitrogen atom (polybenzimidazole) (pg. 9, line 15 to pg. 10, line 5) and at least one mineral acid (phosphoric acid) (pg. 13, lines 19-30). Bjerrum et al. discloses wherein at least one electrode comprises a catalyst comprising a composite of platinum with chromium, titanium or tungsten (pg. 16, lines 20-26). Bjerrum et al. does not specifically disclose wherein the catalyst consists of one of the combinations disclosed in the claim.

However, Itoh et al. teaches of a platinum alloy-supported catalyst consisting of platinum alloyed with another metal such as nickel (col. 3, lines 20-46). At the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the catalyst of Bjerrum et

al. with a platinum-nickel alloy, because Itoh et al. teaches that such a catalyst has a superior electrochemical oxygen reduction activity, superior long-term stability and the catalyst exhibits a higher out-put and a longer lifetime (col. 3, lines 1-5).

Response to Arguments

7. Applicant's arguments with respect to claims 1, 3-34 and 36-37 have been considered but are moot in view of the new ground(s) of rejection as necessitated by Applicant's amendments to the claims.

8. Applicant's arguments filed January 06, 2012 have been fully considered but they are not persuasive.

Applicant's principal arguments are:

a) Buchanan relates to an acid electrolyte and not a polymer electrolyte as claimed (claim 1).

b) Examiner is considering the two "different" electrolytes of Bjerrum and Buchanan as being functionally equivalent (claim 1).

c) Buchanan only mentions the use of gold to improve the catalyst, not nickel (claim 1).

d) There is no teaching in Kiefer of which steps have to be taken to improve the performance of a catalyst for polyazole/phosphoric acid PEM (claims 2 and 25-27).

e) Buchanan teaches away from using Pt/Ni for acid electrolytes and the Examiner is picking individual elements from Buchanan and combining them while already knowing the solution to the instant problem.

In response to Applicant's arguments, please consider the following comments:

a) Polymer electrolytes can comprise acids. Furthermore, claim 1 uses open-ended language "comprising" which does not exclude acids. Even furthermore, Buchanan teaches that the catalysts can be used in PEM fuel cells (col. 2, lines 48-56).

b) Examiner did not make such a statement. Buchanan teaches that catalysts used fuel cells such as Ni and Ti in combination with Pt as being functionally equivalent.

c) Buchanan clearly mentions the use of nickel with platinum as a catalyst for a PEM fuel cell, as well as with the addition of gold to improve the catalyst. Furthermore, claim 1 can comprise gold with the platinum and nickel catalysts.

d) In response to applicant's argument that Kiefer does not take steps to improve the performance of a catalyst, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

e) Examiner is not sure for which claims these arguments pertain to. Claim 1 does not exclude the use of gold. "Consisting essentially of" language does not exclude all other elements from the claim. The transitional phrase limits the scope of the claim to the specified materials "and those that do not materially affect the basic and novel characteristics" of the claimed invention. *In re Herz*, 537 F.2d 549, 551-52 190 USPQ 461, 463 (CCPA 1976). Buchanan further provides motivation for modifying the reference of Bjerrum. If the prior art reference discloses a list of materials which can be advantageously used, the Examiner can pick and

choose between the materials to show obviousness over the claimed limitations, because they were conceived in the prior art. The Applicant must provide unexpected results for the claimed configuration to show non-obviousness.

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ADAM A. ARCIERO whose telephone number is (571)270-5116. The examiner can normally be reached on Monday to Friday 7am to 4pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Barbara Gilliam can be reached on 571-272-1330. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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